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"Who do you know?" Developing and Analyzing Entrepreneur Networks: An Analysis of the Entrepreneurial Environment of Addis Ababa, Ethiopia

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14. ABSTRACT

Our research goal is to quantify the entrepreneurial network in such a way that the analysis provides concrete policy recommendations. Our Center has experimented with several data collection methodologies and we have developed an innovative yet simple technique that allows us to develop quantifiable entrepreneur networks. Our innovation is not to develop each individual entrepreneur's network but to understand the entire entrepreneurial network of the community in which the entrepreneur lives and operates. In order to develop this model, we have adapted a technique used in sociology to measure social capital called the Position Generator (Lin & Dumin, 1986; Lin et Al, 2001). This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. By approaching the entrepreneur's network through the analysis of his connections to prominent structural positions in the community or society, researchers are able to construct measures that obtain information on the strength of ties and structural holes (Lin, 2001). For example, in a developing world entrepreneurial network these roles might include a non-governmental organization, a government program, or a family member.

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Abstract

Our research goal is to quantify the entrepreneurial network in such a way that the analysis provides concrete policy recommendations. Our Center has experimented with several data collection methodologies and we have developed an innovative yet simple technique that allows us to develop quantifiable entrepreneur networks. Our innovation is not to develop each individual entrepreneur's network but to understand the entire entrepreneurial network of the community in which the entrepreneur lives and operates. In order to develop this model, we have adapted a technique used in sociology to measure social capital called the Position Generator (Lin & Dumin, 1986; Lin et Al, 2001). This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. By approaching the entrepreneur's network through the analysis of his connections to prominent structural positions in the community or society, researchers are able to construct measures that obtain information on the strength of ties and structural holes (Lin, 2001). For example, in a developing world entrepreneurial network these roles might include a non-governmental organization, a government program, or a family member.

Sequential to this effort, we will designate a "goal network," an entrepreneurial environment that is considered to be especially conducive for successful Small and Medium Enterprises (SMEs) establishment. We will construct a network model using the same methodology and then mathematically determine which nodes in the "network of interest" are the "driver nodes." By influencing these nodes, or their links to other nodes, we can encourage the "network of interest" to evolve towards the propitious centrality metrics of the "goal network." The quantitative findings from this methodology will determine specific policy recommendations for each network based on its own specific centrality metrics.

Author's Note

In a previous paper, "'Who do you know?' Developing and Analyzing Entrepreneurial Networks: An Analysis of the Entrepreneurial Environment of Kampala, Uganda," I addressed the importance of Small and Medium Enterprises (SMEs) in the developing world, the challenges of quantifying entrepreneurial networks, the challenges of appropriate data collection so that it results in actionable knowledge, as well as our innovative survey instrument. I have included this background for readers who have not read the Kampala research paper.

Background

The facilitation of entrepreneurship and the establishment of Small and Medium Enterprises (SMEs) in the developing world is one of the keys to addressing many of the world's social and economic problems. Major international organizations such as the World Bank, International Monetary Fund, and the United Nations agree that SMEs are engines of growth, essential for a competitive and efficient market and critical for poverty reduction.

Sociologists, economists, and network scientists concur that the entrepreneur's network, or specifically the people and organizations they interact with, are essential to his or her ability to identify and evaluate new business opportunities, access vital resources, and succeed economically. These practitioners have consistently struggled with developing models that are measurable or quantifiable. Most research on this subject tends to focus on the entrepreneur's social network and utilizes the Name Generator approach to develop the social network model. This method maps an ego-centered network and assembles an inventory of information about every social contact, such as the relationship between the person under analysis and the people within the social network.

The Name Generator approach creates numerous challenges. First, the person under analysis might be hesitant to provide names. Additionally, in many cultures, spelling may be an issue and the use of nicknames or numerous surnames make it challenging to determine the true identity of members of the networks. Finally, a member of the network may leave the network for numerous reasons but the role they serve in the network remains filled by another individual. Because of these issues, our team has determined that the Name Generator approach to network development is not appropriate in order to achieve our research goals.

Research Goal

Our research goal is to quantify the entrepreneurial network in such a way that the analysis empowers decision-makers with the requisite knowledge to develop specific policy recommendations. After experimenting with several data collection methodologies we

adapted a technique used in sociology to measure social capital called the Position Generator. This technique circumvents the massive effort of mapping an individual's social network before locating the social resources in it. Our innovation is not to develop each individual entrepreneur's social network but to understand the entire entrepreneurial network of the community in which the entrepreneur lives and operates. By approaching the entrepreneur's network through the analysis of his connections to prominent structural roles in the community or society, we are able to construct models that can determine the influence of each role in specific entrepreneurial environments. For example, in a developing world entrepreneurial network these roles might include a non-governmental organization, a government program, or a family member.

Our research team has developed an innovative survey that allows us to aggregate each respondent's input forming a network model that accurately measures the entrepreneurial environment in a particular location. The survey was tested during a visit to Addis Ababa, Ethiopia, during July of 2012, and we conducted our first data collection during a visit to Kampala, Uganda in April of 2013. This paper will focus on an initial descriptive analysis of the data collected in Addis Ababa, Ethiopia.

Data Collection

The team selected Addis, Ababa as its second data collection site for two reasons:

1. Our relationship with Afrilabs, a network organization of 16 innovation hubs throughout the African continent. Additionally, I had previously been introduced to Jon Gosier, a software developer and designer working at the intersection of open data, human rights, and African development. Jon is the founder or co-founder of several organizations and initiatives some of which include AfriLabs and Appfrica. iceaddis, Ethiopia's first high tech innovation hub, is a member of the AfriLabs network and the staff graciously agreed to assist with this data collection effort.
2. Ethiopia is one of Africa's fastest growing economies. The current government has set the conditions for economic growth and has encouraged the growth of small businesses. There is a large and growing population of ambitious young people who are aggressively creating new business ideas and developing numerous small businesses. Additionally, Addis Ababa is the home of the Ethiopian Institute of Architecture, Building Construction, and City Development, a center of innovation in Ethiopia (iceaddis is located on the campus), as well as Addis Ababa University, the oldest and largest university in Ethiopia. The student bodies at both schools are energetic and tech savvy.

Based on our coordination with the staff of iceaddis, I was able to interview and collect data from over 50 entrepreneurs in Addis Ababa.

Position Generator Survey

In order to collect the necessary data, the team has developed a six-question survey that gathers some basic demographic data yet keeps the respondent's identity anonymous. The survey analyzes six different focus areas in the network:

1. Business Registration
2. Start-Up Capital
3. Equipment
4. Legal Issues
5. Infrastructure
6. Human Resources

Each of the six questions is similarly structured. The questions ask the position or role the subject would most likely approach in order to get assistance with one of the focus areas. For example, the first question asks:

> "If you require assistance with the **legal registration** of your business, who would you most likely approach in order to address this issue?"

Each of the questions has the same possible responses:

1. Myself
2. Government Representative
3. Government Business Development Program
4. Private Incubator
5. Non-Governmental Organization
6. Venture Capitalist or Angel Investor
7. Family Member
8. Religious Leader
9. Someone in Social Network
10. Commercial Bank
11. White Collar Professional
12. Military Leader
13. Education Leader

This particular survey structure allows for the development of network models that can be accurately compared and contrasted.

Analysis

Over the course of four days, I was able to interview 56 local entrepreneurs. Based on their answers to the survey, we developed the matrix depicted in Table 1 that

captures the number of times that each entrepreneur answered a specific role to one of the six survey questions.

Based on this collected data, we developed an initial network (Figure 1) that illustrates how the respondents are connected to each of the roles in the network. The resulting network model is interesting but still does not present the necessary insights to a policy maker. The ability to understand the influence that each role possesses and its relationship to other roles in the entrepreneurial network is vital to effective policy making. Fortunately, network analysis techniques allow us to quantify this influence.

	Self	Govt Rep	Govt Biz Dev	Incubator	NGO	Investor	Family	Religious	Social Network	Bank	Prof	Military	Education
1	1	2	0	0	0	0	1	0	0	0	2	0	0
2	0	0	0	0	1	0	2	0	3	0	0	0	0
3	1	1	0	0	0	0	2	0	2	0	0	0	0
4	1	0	0	0	0	0	4	0	1	0	0	0	0
5	1	0	1	1	0	0	0	0	2	0	1	0	0
6	1	0	1	1	0	0	1	0	2	0	0	0	0
7	1	1	0	0	1	0	1	0	2	0	0	0	0
8	1	3	0	0	1	0	0	0	1	0	0	0	0
9	4	1	0	0	0	0	1	0	0	0	0	0	0
10	2	0	0	1	0	0	0	0	1	1	1	0	0
11	1	1	0	0	1	0	2	0	0	0	0	0	1
12	0	1	1	0	1	0	0	0	1	1	0	0	1
13	0	2	0	0	0	0	2	0	1	0	1	0	0
14	0	1	2	0	1	0	0	0	2	0	0	0	0
15	1	0	0	1	0	0	1	0	3	0	0	0	0
16	0	1	0	0	1	0	1	0	2	1	0	0	0
17	1	0	1	0	0	0	0	0	3	1	0	0	0
18	0	1	1	0	0	0	2	0	2	0	0	0	0
19	0	0	0	2	1	0	1	0	2	0	0	0	0
20	1	0	0	1	0	0	0	0	2	0	1	0	1
21	2	0	0	0	0	0	0	0	3	0	1	0	0
22	2	0	0	0	0	0	0	0	3	0	1	0	0
23	2	0	0	0	0	0	1	0	3	0	0	0	0
24	0	0	0	0	0	0	2	0	4	0	0	0	0
25	2	0	0	0	0	0	0	0	4	0	0	0	0
26	1	0	1	0	0	1	1	0	0	0	1	0	1
27	0	0	0	0	0	0	1	0	5	0	0	0	0
28	3	1	1	0	0	0	0	0	1	0	0	0	0
29	1	0	0	0	0	0	1	0	3	0	0	0	1
30	2	1	0	0	0	1	1	0	1	0	0	0	0
31	2	1	0	1	0	0	0	0	1	0	1	0	0
32	0	1	0	0	0	0	3	0	2	0	0	0	0
33	1	1	0	0	0	0	2	0	2	0	0	0	0
34	2	1	0	0	0	0	0	0	3	0	0	0	0
35	0	0	0	0	0	0	3	0	0	0	3	0	0
36	1	2	0	0	0	0	1	0	0	0	2	0	0
37	2	1	0	0	0	0	0	0	1	0	2	0	0
38	2	0	0	0	0	1	0	0	3	0	0	0	0
39	3	1	1	0	0	0	0	0	1	0	0	0	0
40	1	0	0	0	0	0	3	0	0	0	1	0	1
41	3	1	0	0	0	0	0	0	0	0	2	0	0
42	1	1	0	0	0	0	4	0	0	0	0	0	0
43	0	1	0	0	0	0	4	0	0	0	1	0	0

44	1	1	0	0	0	1	0	0	2	1	0	0	0
45	1	1	0	0	2	0	1	0	0	0	1	0	0
46	2	2	0	0	0	0	2	0	0	0	0	0	0
47	1	2	0	0	0	0	0	0	0	1	2	0	0
48	0	1	0	0	0	0	2	0	0	0	3	0	0
49	1	1	0	1	0	0	1	0	0	0	2	0	0
50	2	0	0	1	0	0	2	0	0	0	1	0	0
51	2	0	0	0	0	0	1	0	0	2	1	0	0
52	0	2	3	1	0	0	0	0	0	0	0	0	0
53	3	1	0	1	0	0	1	0	0	0	0	0	0
54	1	2	0	0	0	0	2	0	0	0	1	0	0
55	3	1	0	0	0	0	2	0	0	0	0	0	0
56	3	0	1	0	0	0	0	0	1	1	0	0	0

Table 1-Raw data

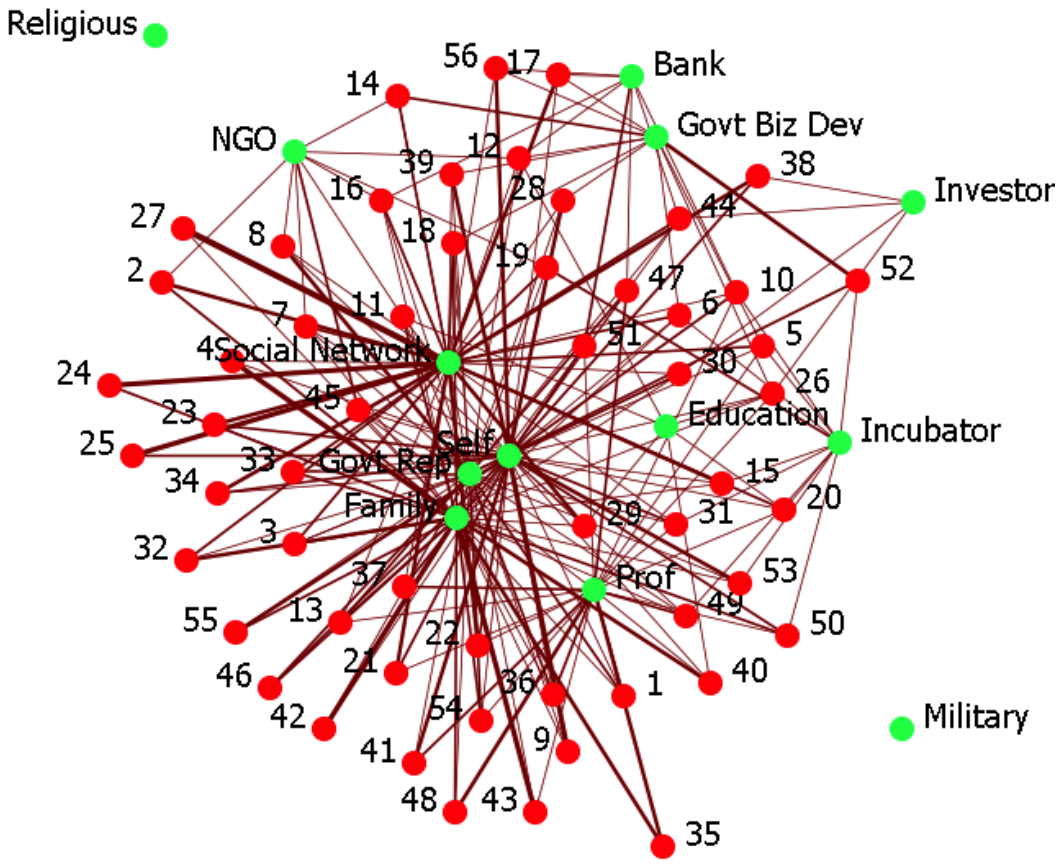

Figure 1. Initial Entrepreneur Network

A technique commonly referred to as “data folding” uses matrix algebra techniques to enable us to infer both influence and relationships of the roles in this particular network. This technique takes the original two-mode network (survey respondents and roles) and converts it to a single-mode network. In this case, it illustrates how the roles are connected through the respondents and captures the

weighting of the number of times that the respondent answers a survey question citing a specific role.

	Self	Govt	Govt BizDev	Incubator	NGO	Investor	Family	Social Network	Bank	Professional	Academia
Self	0	50	13	14	5	6	55	80	12	36	5
Govt	50	0	12	5	10	2	46	30	5	28	2
Govt BizDev	13	12	0	5	3	1	4	17	3	2	2
Incubator	14	5	5	0	2	0	8	15	1	7	1
NGO	5	10	3	2	0	0	9	13	2	2	2
Investor	6	2	1	0	0	0	2	6	1	1	1
Family	55	46	4	8	9	2	0	61	3	37	7
Social Network	80	30	17	15	13	6	61	0	10	15	6
Bank	12	5	3	1	2	1	3	10	0	5	1
Professional	36	28	2	7	2	1	37	15	5	0	3
Academia	5	2	2	1	2	1	7	6	1	3	0

Table 2-Role x Role Matrix

Based on this resulting matrix, we can now develop the single mode network model illustrated in Figure 2. The nodes in Figure 2 are sized by eigenvector centrality (a measure of how connected a node is to other influential nodes) and the links are weighted based on the strength of the connection between the nodes. A visual inspection of the network model illustrates the influence of several roles in the network. For instance, Self, Social Network, Family, and Government are very central in the network. Because this network model is derived from a weighted matrix, the influential nodes are not always in the center of the illustrated network model. Interestingly, both Military and Religion are not connected to the network, indicating that these roles are not influential in the Addis Ababa entrepreneurial environment.

Network analysis techniques enable us to quantitatively characterize the nodes in this network. For our initial analysis, we will focus on three common measures commonly referred to as centrality metrics.

1. Degree Centrality-a measure of how important or influential a node is based on the number of connections a node has in comparison to the total possible number of connections in the network. Nodes that are high in degree centrality tend to be in the center of the network graph.
2. Eigenvector Centrality-a measure of how connected a node is to other influential nodes. Nodes that have a high eigenvector value tend to be the most influential and sometimes it identifies hidden influencers.
3. Betweenness Centrality- a measure of how many sub-groups within the network

of which the node is a member. Nodes that have a high betweenness value tend to connect sub-groups within the network.

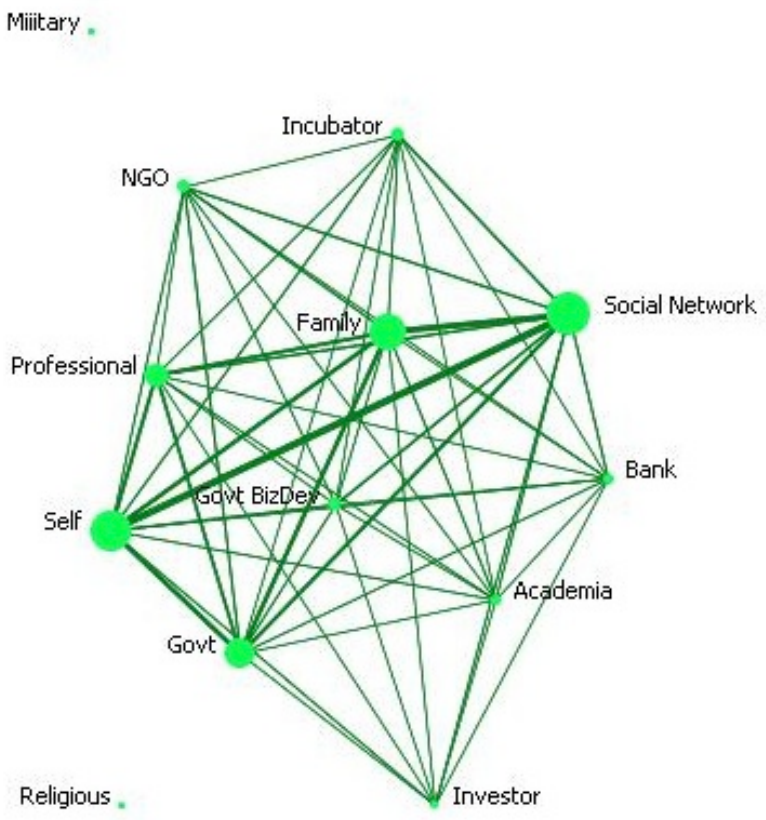

Figure 2. Role by Role Network

Table 3 contains a summary of the centrality metrics for the Addis Ababa entrepreneur network. The centrality metrics are normalized from 0 to 1; this enables us to effectively compare the nodes within this network. For example, an analysis of degree centrality indicates that Self is approximately twice as influential as Professional (.288 to .142).

	Degree	Eigenvector	Betweenness
Self	0.288	0.732	0.000
Govt	0.198	0.543	0.000
Govt BizDev	0.065	0.172	0.000
Incubator	0.060	0.170	0.000
NGO	0.050	0.136	0.005
Investor	0.021	0.061	0.309
Family	0.242	0.659	0.000

Religious	0.000	0.000	0.000
Social Network	0.264	0.681	0.000
Bank	0.045	0.122	0.043
Professional	0.142	0.412	0.009
Military	0.000	0.000	0.000
Academia	0.031	0.082	0.213

Table 3-Network Centrality Metrics

Our initial analysis of the survey data yields some interesting insights. Confirming the visual inspection, Social Network and Self have the highest values in both degree and eigenvector centrality. Interestingly, they both do not appear to be a connector between the roles; they both have a betweenness centrality value of 0.

A side-by-side comparison of degree and eigenvector centrality measures in descending order confirms that both measures are correlated; the roles' order of influence are the same using both centrality measures.

	Degree	Eigenvector
Self	0.288	0.732
Social Network	0.264	0.681
Family	0.242	0.659
Govt	0.198	0.543
Professional	0.142	0.412
Govt BizDev	0.065	0.172
Incubator	0.060	0.170
NGO	0.050	0.136
Bank	0.045	0.122
Academia	0.031	0.082
Investor	0.021	0.061

Table 4-Degree and Eigenvector Centrality Comparison

An analysis of betweenness centrality (Table 3) yields more interesting insights. Using betweenness centrality to compare, we find that the Education and Investor roles play an important connecting role in the entrepreneurial network.

An Analytical Challenge

The survey data that we collected is weighted because we "count" the number of times a respondent selects a particular "position or role" in response to a survey question as illustrated in Table 1. This is problematic when we use the "data folding" technique because it involves matrix multiplication and the resulting values in the new

matrix exaggerate the scale of the relationships between the nodes. A relationship that is nominally strong in the original two-mode matrix receives a profoundly higher weighting in the final Role by Role matrix.

A network analysis technique commonly used to avoid this issue is to binarize the data (links either exist or they don't; zero or one) prior to folding the network. Because the survey instrument captures the number of times a respondent selects a particular role, this technique would lose the strength of the relationships between the roles in the entrepreneurial environment under analysis.

As our project progresses, we will explore other analytical techniques in order to more accurately portray the nodes' influence and the strength of the relationships. Some of these techniques will include several "projection techniques" which are quantitative techniques that utilize additive instead of multiplicative techniques in order to better convey the true information in regards to tie or link-strength in the network.

Conclusion

In addition to the two data sets that we have collected, we will collect similar data from two other entrepreneurial environments in emerging economies. Once these network models are completed, our team will develop quantitative techniques that will enable the classification of each network. Based on this classification technique, we will be able to state, quantitatively, whether the networks are the same or if they are different and what quantitative difference exist.

As previously stated, we will then quantitatively compare the networks with the "goal network" and mathematically determine the nodes in the "network of interest" which are potentially the "driver nodes." These "driver nodes" are nodes that can be influenced in order to make network outcomes more socially desirable (Barabasi, 2011). The quantitative findings from this methodology will determine specific policy recommendations for each network based on its own specific centrality metrics. This methodology also develops a strong foundation for future economic development simulation exercises.

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